

U.S. DEPARTMENT OF ENERGY  
NATIONAL ENERGY TECHNOLOGY LABORATORY

## COLD-FLOW CIRCULATING FLUID-BED UNIT

### CONTACT POINTS

**Lawrence J. Shadle**  
Physical Scientist  
304-285-4647  
lawrence.shadle@netl.doe.gov

**Diane (DeeDee) Newlon**  
Technology Transfer Manager  
304-285-4086  
r diane.newlon@netl.doe.gov

### ADDRESS

#### National Energy Technology Laboratory

3610 Collins Ferry Road  
P.O. Box 880  
Morgantown, WV 26507-0880  
304-285-4469 fax

626 Cochran's Mill Road  
P.O. Box 10940  
Pittsburgh, PA 15236-0940  
412-386-4604 fax

### WEBSITE

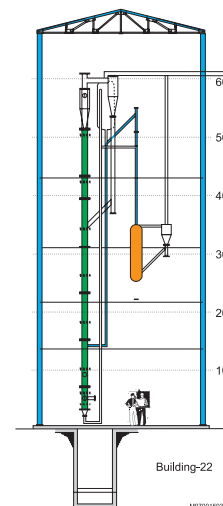
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### Capabilities

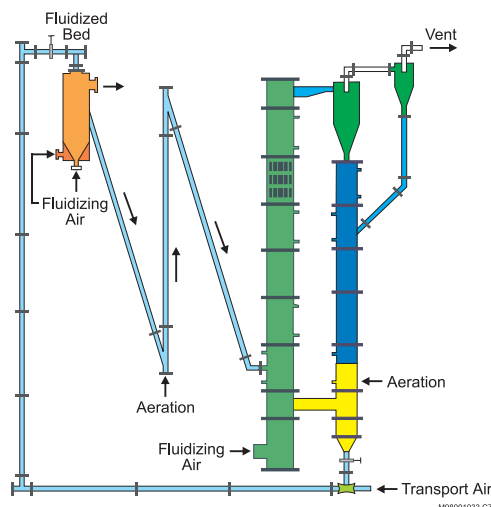
A cold model operated at NETL is a flexible and versatile facility. Validation experiments are needed to improve reliability and accuracy of computer models needed for new fluid bed process design and optimization. Solid transfer issues are encountered in both integrated gasification combined-cycle (IGCC) and advanced pressurized fluidized-bed combustion (APFBC) power trains. Tools are needed to visualize solids flow systems and explore possible solutions to problems. The project team's objective is to provide support to circulating fluid-bed (CFB) systems through validation of computational Fluid Dynamic models, analysis of existing plants, optimization of plant operations, and evaluation of new designs.

The cold-flow unit is capable of simulating fully integrated operations for solids transfer and control systems as is common to many advanced coal-fired power systems. Currently, DOE is providing financial support for operations or design and construction of six CFB process plants.

The cold-flow unit consists of a riser, a two-stage cyclone, a standpipe, and a make-up feed hopper. It will shortly include a 2-ft diameter fluidized bed (FB) with a cyclone and barrier filter. Transport lines connect these vessels in a variety of configurations with mechanical and non-mechanical solids control valves. The main riser is 1-ft diameter, 56-ft high, and consists of metal and acrylic spool pieces. The facility has a supply of 250,000 scfh air with the ability to obtain superficial velocities of 10 to 40 ft/s in the riser, and 0.2 to 0.7 ft/s in the FB. The operating pressures range from 0 to 15 psig at the riser outlet and up to 30 psig in the FB.



*Elevation drawing  
of cold flow unit*



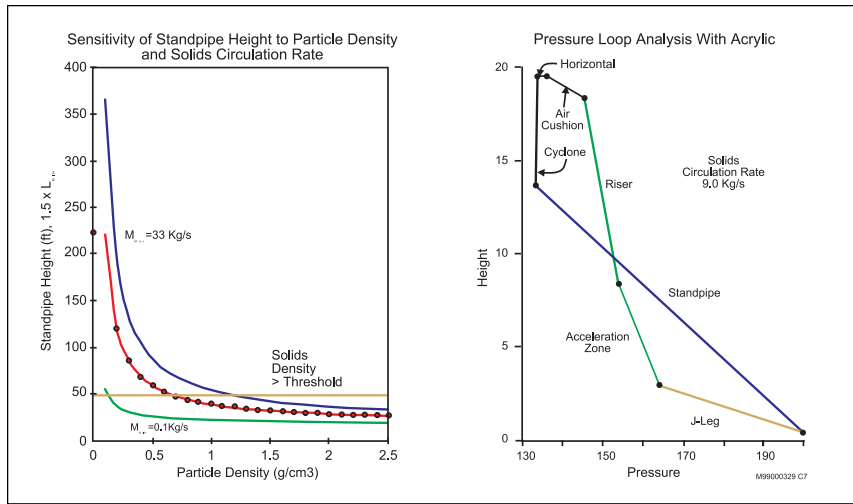
*Simplified process flow diagram for the  
cold flow circulating fluid-bed test facility*

Operating regimes for coke, cork, acrylic and polyvinyl chloride particles have been conducted using a 45-angle inclined J-valve, an L-valve, and a Loopseal. In addition to the standard process measurements such as pressures and gas flows, advanced instrumentation is used to characterize gas solids hydrodynamics. Advanced instrumentation available at the NETL facility includes laser particle velocity, wall shear, spiral packed bed velocity, and capacitance density measurements.

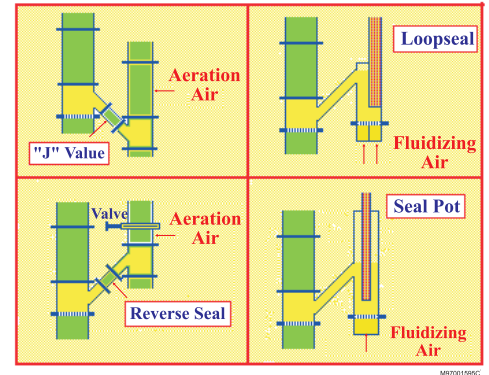
Construction of the N-valve, Fluid Bed unit and associated particle separators and transfer lines was completed in 2001 and shakedown testing completed in 2002. The operating envelope and start-up and shutdown sequences were determined for this potential char transfer device.



# COLD-FLOW CIRCULATING FLUID-BED UNIT



*Pressure profiles and operating conditions achievable in the cold flow test facility*



*Non-mechanical valve configurations to be tested*

## Opportunities

The cold-flow circulating fluid-bed unit provides the following opportunities:

- A user's test facility for private industry to test specific component designs and configurations.
- Better understanding of operational principles of gas-solid transfer and control among reactor vessels.
- Data to verify the mathematical models; use these data to develop stochastic and engineering models.
- Design and scale-up data of gas-solid transfer devices.
- A platform to develop and test instrumentation and novel non-mechanical valves, down-comers, and other devices.
- A training simulator for plant operating personnel. Replace the schedule figure on page 2 with the figure above.

## CFCFB Facility Test Schedule

